

B. TECH.

**FOURTH SEMESTER EXAMINATION, 2002-2003
THEORY OF AUTOMATA & FORMAL LANGUAGES**

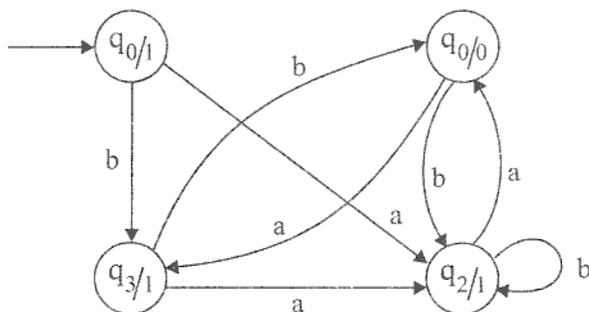
Time : 3 Hours

Total Marks : 100

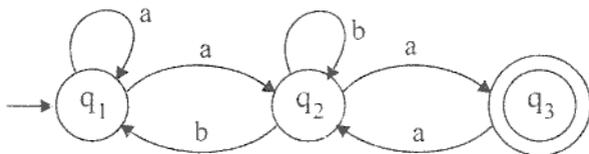
Note : Attempt ALL the questions.

1. Attempt any FOUR of the following :— (5×4=20)

(a) What is Moore Machine ? Change the given Moore machine into Mealy machine :—

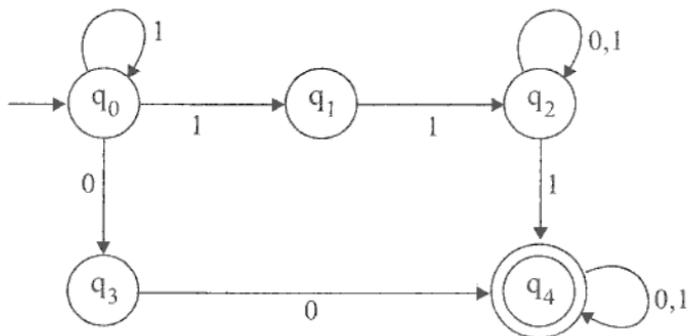


(b) Find out Regular Expression of the given diagram :



(c) Give deterministic finite automata accepting the following languages over the alphabet {0, 1} :—

- (i) The set of all strings ending in 00.
- (ii) The set of all strings such that every block of five consecutive symbols contains at least two 0's.
- (d) Construct a DFA equivalent to the following NDEFA :—



- (e) What is the difference between Two-way Finite Automata (2 DFA) and One-way Finite Automata ?
- (f) Find the regular grammar for the language
- $$L = \{a^n b^m \mid n+m \text{ is even}\}.$$

2. Attempt any FOUR of the following :— (5×4=20)

- (a) State Myhill - Nerode Theorem.
- (b) What is Ambiguity ? Show that $S \rightarrow as \mid Sa \mid a$ is an ambiguous grammar.
- (c) Convert the given grammar in Chomsky Normal Form (CNF) :

$$S \rightarrow ABa$$

$$A \rightarrow aab$$

$$B \rightarrow Ac$$

(d) Show that $L = \left\{ ww \mid w \in \{a,b\}^* \right\}$ is not regular set.

(e) Explain Pumping Lemma for CFL. Consider the following language :—

$$L = \left\{ a^n b^n c^n \mid n \geq 1 \right\}$$

Using pumping lemma, show that L is not a CFL.

(f) Show the derivation tree for string 'aabbbb' with the following grammar :—

$$S \rightarrow AB / \varepsilon$$

$$A \rightarrow aB$$

$$B \rightarrow Sb$$

3. Attempt any TWO of the following :— (10×2=20)

(a) Write down the algorithm to determine whether CFL is

- (i) Empty,
- (ii) Finite or
- (iii) Infinite.

(b) Explain the difference between Deterministic and Non-Deterministic Push Down Automata giving their definition. Illustrate with an example of each.

(c) Construct PDA for the following

$$L = \left\{ a^n cb^{2n} \mid n \geq 1 \right\}$$

over the alphabet $\Sigma = \{a, b, c\}$.

4. Attempt any TWO of the following :— (10×2=20)

(a) Define a Turing Machine. Design a Turing Machine that accepts the language

$$L = \left\{ a^n b^{n+1} \mid n > 0 \right\}.$$

- (b) Does the Post Correspondence Problem (PCP) with two lists $x = (b, bab^3, ba)$ and $y = (b^3, ba, a)$ have a solution?
- (c) State True / False with reason :—
- (i) Every language described by regular expression can be recognised by DFA.
 - (ii) Every recursively enumerable language can be generated by a CFL.
 - (iii) The halting problem of TM is decidable.
 - (iv) Complement of any recursively enumerable language is also enumerable.
 - (v) Every CFL can be recognised by TM.
5. Attempt any TWO of the following :— (10×2=20)
- (a) Show that $L = \{ a^n b^n c^n \mid n \geq 1 \}$ is not context-free but context-sensitive.
 - (b) Give the production rule for Type 0, Type 1, Type 2 and Type 3 grammars of Chomsky hierarchy.
 - (c) Show that CSL are closed under :
 - (i) Union
 - (ii) Substitution
 - (iii) Concatenation
 - (iv) Intersection.